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Metapopulation structure of the Common Hamster (*Cricetus cricetus*) in an agricultural landscape

Metapopulationsstrukturen des Feldhamsters (*Cricetus cricetus*) in einer Agrarlandschaft

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Kurzfassung: Wir beobachteten Subpopulationen des Feldhamsters (*Cricetus cricetus*) in einer 1.550 ha großen Agrarlandschaft in Ungarn. Feldhamster von unterschiedlichen Nahrungsgebieten bilden Subpopulationen, die in Verbindung zueinander stehen. Diese Subpopulationen erscheinen und verschwinden regelmäßig während des Jahres. Einzelne Tiere verlassen unbewohnbar gewordene Habitate direkt in eines der benachbarten Subpopulationen oder in die Randstreifen bzw. in Luzerneschläge, von wo sie später weiter entfernte Subpopulationen erreichen. Anscheinend sind die Randstreifen der intensiv bewirtschafteten großen Luzerne-, Getreide-, Weizen- und Zuckererbsenschläge für einen dauerhaften Fortbestand der Metapopulationen des Feldhamster von existenzieller Bedeutung.

Introduction

To date, population models draw attention to the fact that resources are not homogeneously available in space for animal populations. In fact, substantial resource heterogeneity can be observed in nature (LEFKOVITCH & FAHRIG 1985; VERBOOM & LANKESTER 1991). This heterogeneity can be considered a major factor that regulates populations, especially in agricultural areas (KOZAKIEWICZ 1983). Spatial fragmentation of the landscape results from the break up of large continuous habitats into smaller ones, which is also conspicuous in agricultural areas (MERRIAM 1988; OPDAM 1988).

For a given species, the spatial arrangement of habitat patches may represent a dynamic mosaic with several, possibly synergistic advantages (such as hamster, field vole). Dispersal of many species is limited by the lack of suitable habitat patches and an unsuitable landscape matrix functioning as a barrier. Such a network of semi-isolated local populations form a so-called metapopulation (LEVINS 1970), where the sub-populations go extinct periodically, and where new ones are formed by colonisation. There is a frequent migration and settlement among the patches structured in space, in time and functionally. According to BOORMAN and LEVITT (1973), reservoir patches exist in a metapopulation where parts of the individuals survive even unfavourable conditions and from where colonisation of newly habitable patches takes place. From time to time, rodents may cover unexpectedly far distances during their roaming (LIRO & SZACKI 1987; WEGNER & MERRIAM 1990). These distances may be significantly larger in a heterogeneous compared to a homogeneous environment (KOZAKIEWITZ 1993). Mosaic-like areas guarantee to the rodents' needs in small and variable habitat patches.

A given patch can be optimal, sub-optimal or absolutely unsuitable in space and time. Temporal variation of habitat quality forces specimens to either emigrate or hibernate. In general, migration occurs to the nearest suitable habitat patch. This nomadism allows a species to optimally meet with their needs (ANDRZEJEWSKI & BABINSKA-WERKA 1986; SZACKI & LIRO 1991).

Hamsters are found in different kinds of plant-cultivation depending on the respective season. According to the nomadism hypothesis, hamsters always try to find the most suitable fodder plant by migrating among fields. Consequently, some fields become vanished and re-populated within a single year.

Hamster sub-populations are well-defined in space by the mosaic of arable land. At the same time, annual movements connect sub-populations into a metapopulation. That hamster metapopulations are mainly determined by habitat heterogenity will serve as hypothesis to be tested throughout our field study conducted in Hungary.

Methods

Research was carried out in 2001 between 1st of March and 30th of October in the Eastern part of Hungary, where hamster density is highest. A map of landscape heterogeneity was prepared for an area of 1550 hectares by using satellite images, refined through own fieldwork. Presence or absence of hamsters in the parcels was established by monitoring the entrances of their burrows.

Fieldwork was started in March when hamsters woke up from hibernation and opened their burrows. The entrances were counted to determine where hamsters had spent the winter time. Additional information from local hamster trappers were also analysed.

A 13 hectar large parcel of alfalfa was made uninhabited by us. Afterwards, recolonisation by hamsters was studied by weekly observations. Number and location of new entrances were registered. Caught hamsters were sexed and aged, and food remains in the stomach were analysed to gain information on fodder plants.

Results

In spring, most hamsters were found along roads, at banks of drainage ditches and at parcels that had been sugar-beet and alfalfa fields in the previous year. Only a minority of hamsters had spent the winter at last years maize fields. They moved to more favourable areas immediately after awakening. Significant differences could be found regarding the physical condition of animals awakening from hibernation at different kinds of fields. Specimens from former maize fields (n=67) were worst in condition, while those from sugar-beet fields (n=31) were best in physical condition. There was no visible fatty tissue on animals were caught on former maize field (these animals were skinned).

Males woke up one month earlier than females. While 95% of the animals caught between 1st and 15th of March were males (n=110), this portion decreased to 25 % in mid April (n=80).

When hamsters woke up, 60% of the agricultural land was ploughed and free from vegetation. Animals that had hibernated in such areas stayed 1-2 weeks in the ploughed field before they moved to the edge. At that time they could find fresh food in alfalfa fields, edges and in winter-wheat fields which allowed them to stay in these areas (Figure 1). At that time they mainly fed on sprouting weeds. However, we also found earthworms in their stomach.

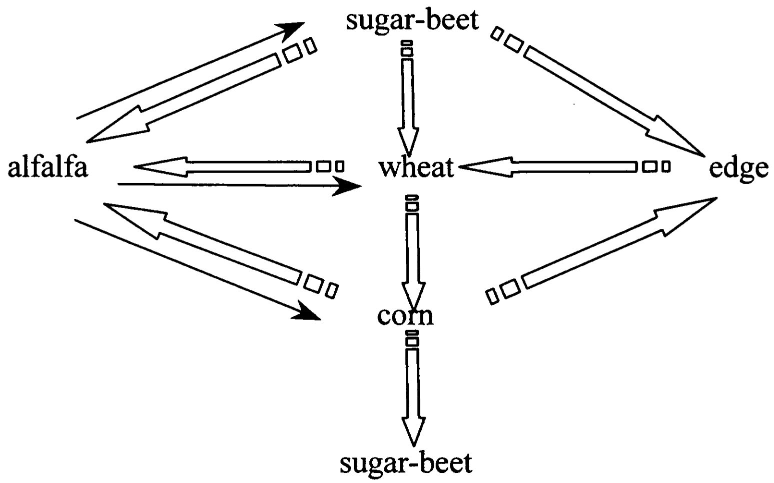

Figure 1: Annual migration of hamster among different habitats
Abbildung 1: Jährliche Wanderungen der Feldhamster zwischen den unterschiedlichen Habitaten

By the middle of June, hamsters disappeared from the edges for unknown reasons. At the same time, the number of hamsters living in alfalfa and fresh wheat increased. Wheat harvesting has also a drastic effect on the hamster population. After harvesting and plough, hamsters moved from wheat fields to alfalfa, where the number of hamsters suddenly increased. In August, part of the hamsters moved from here to maize fields where maize-ear appeared in the meantime.

Harvesting of maize was finished by the middle of October. In those parcels where deep plough was not carried out, hamsters stored up seeds and stayed there during winter. Hamsters living in areas with less favourable conditions moved to the edges to spend the winter.

Discussion

A dynamically changing hamster metapopulation could be identified in the examined area. The hypothesis of nomadism caused by changing food availability in time and space was verified. Food patches – here: different plant fields – determined the presence and density of hamsters. Hamsters living in different food patches form sub-populations that are connected either directly by migrating specimens or via the source population (Figure 2). The source-population plays a significant role in the hamster metapopulation. It is permanently present due to the constant and good foraging conditions. In our study, alfalfa fields serve as source patches for hamsters. Although other food patches are periodically more advantageous (wheat and corn fields), hamsters will return to the alfalfa after their deterioration.

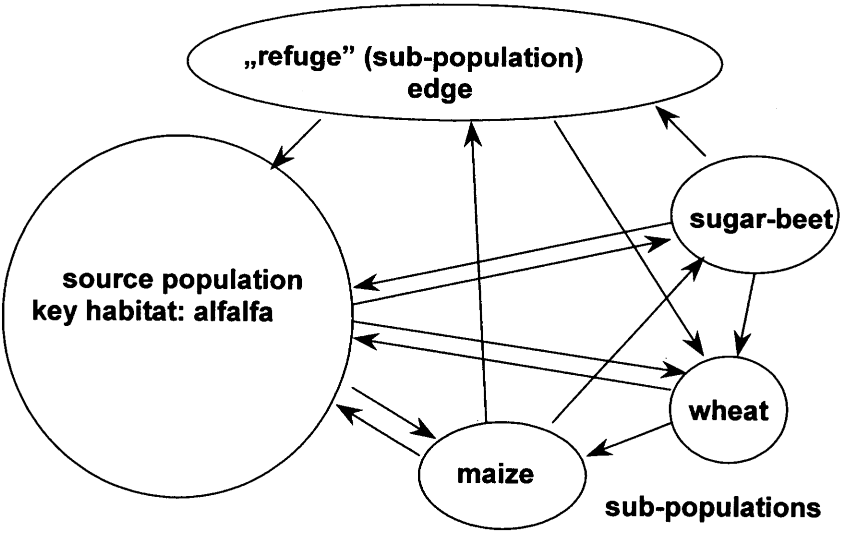

Figure 2: Inter-connections in a hamster metapopulation
Abbildung 2: Beziehungen der Metapopulationen des Feldhamsters

Edge habitats play a specific role in the life-cycle of a hamster metapopulation. Although never being the most optimal food resource, edges serve as refugia, providing almost always at least a certain food supply, even at lower level. Hamsters enter the edge from unfavourable habitats, e. g. after harvesting, and survive there uncomfortable times. The edge has an indispensable role in those areas where there is no longer alfalfa or another favourable food patch within an accessible distance. Thus, the edge practically acts as a buffer. It allows hamster to live in areas where conditions for survival are unstable. As soon as possible, hamsters leave the edge towards more favourable habitats.

Sub-populations of a hamster metapopulation live in fields of sugar-beet, wheat, corn, and some other rarely produced plants (e. g. poppy, apple, pea). These sub-populations appear and disappear periodically throughout a year. Hamsters migrate from deteriorating habitats either directly to a neighbouring sub-population or to the alfalfa and the edge-zone. From here they may later on pass to other sub-populations.

The common hamster is a frequent and common species in Hungary east of the Danube river. As long as intense cultivation of large parcels producing the four basic fodder plant and the edges persists, we are not concerned about a decline of hamster populations in this area.

Aknowledgements

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